High Performance Based Design for the Building Envelope

Fenestration Committee

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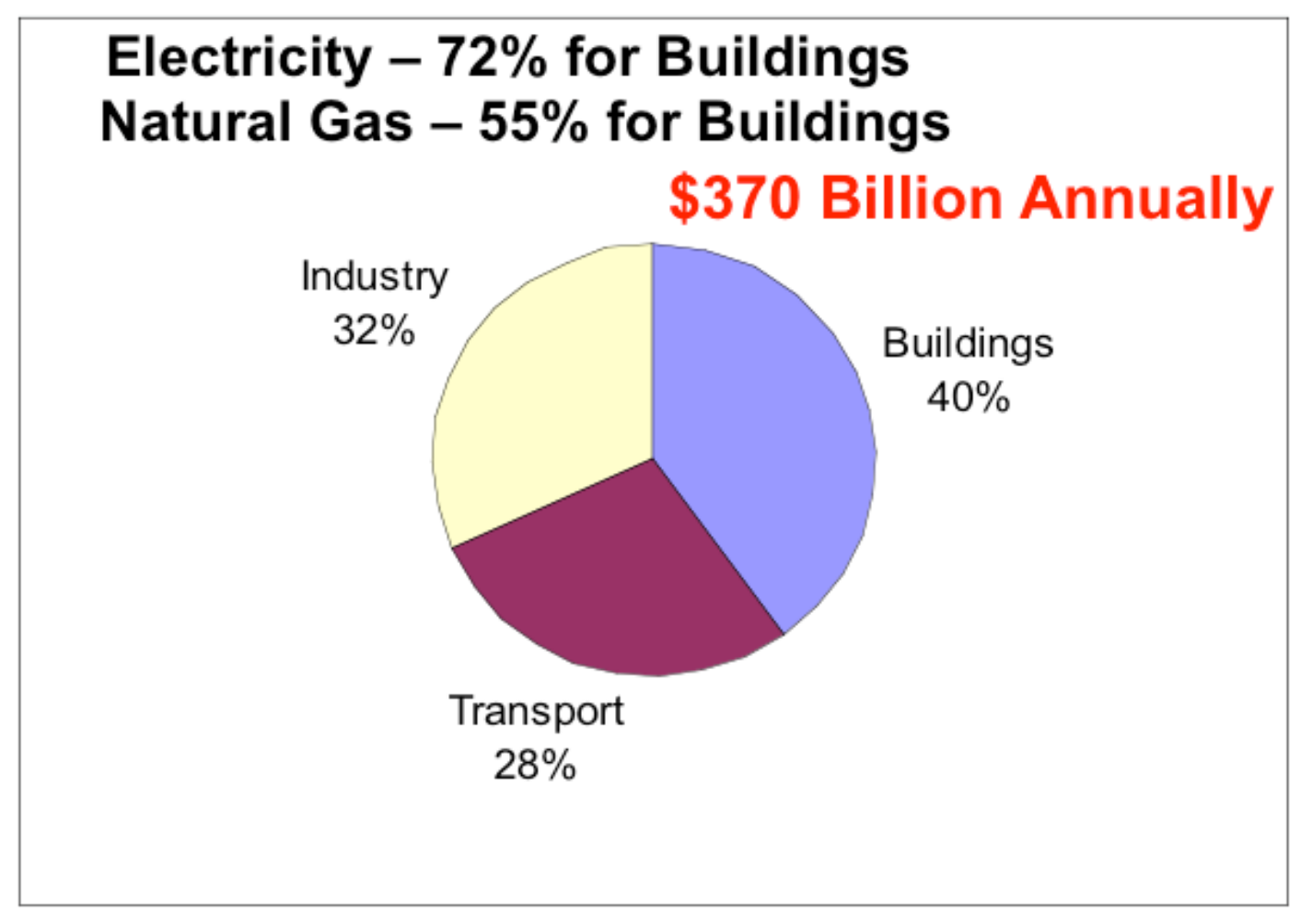
Energy Use in Buildings



Source: LBNL windows research summary, Selkowitz etal

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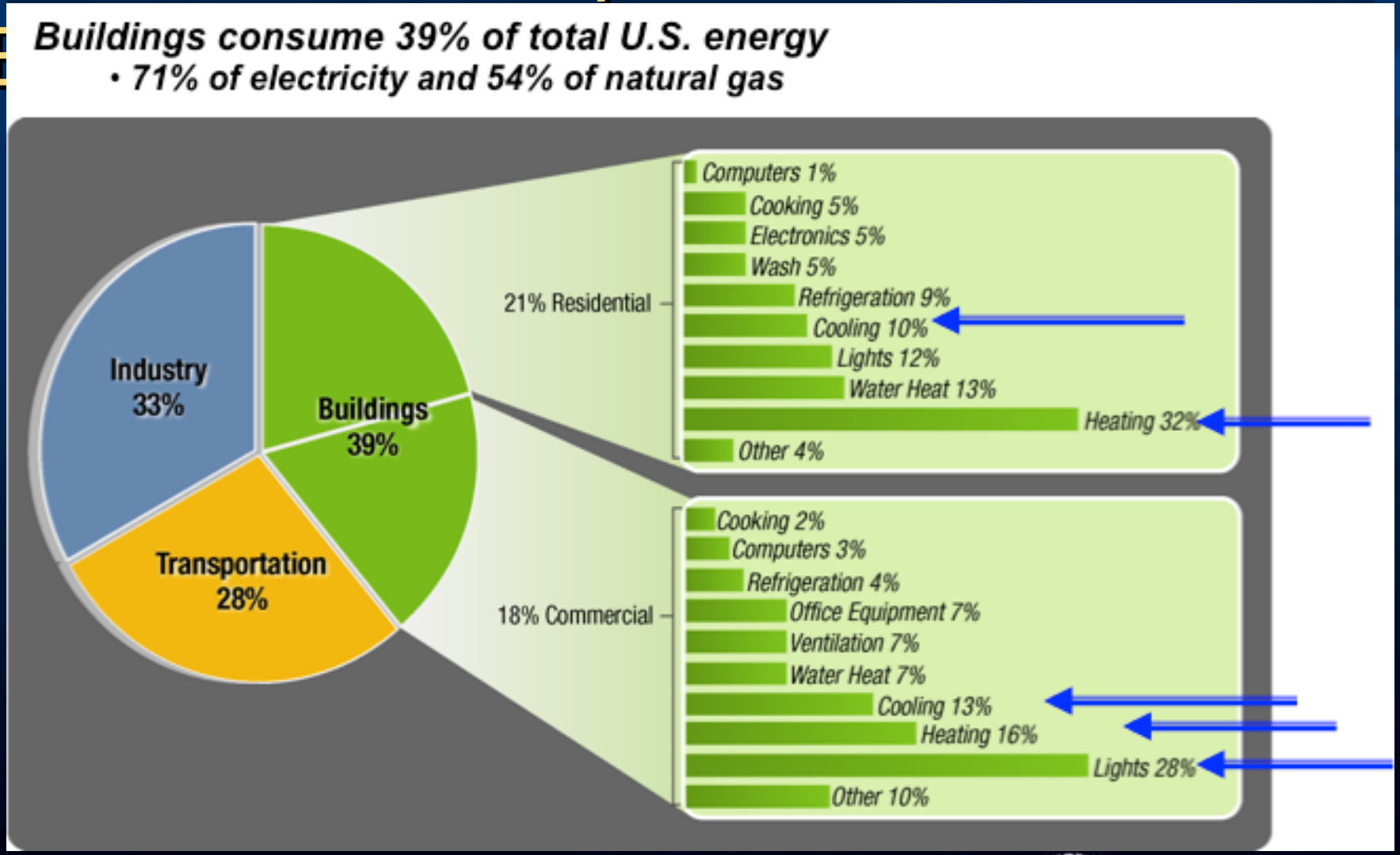
Fenestration Impacts on End Use



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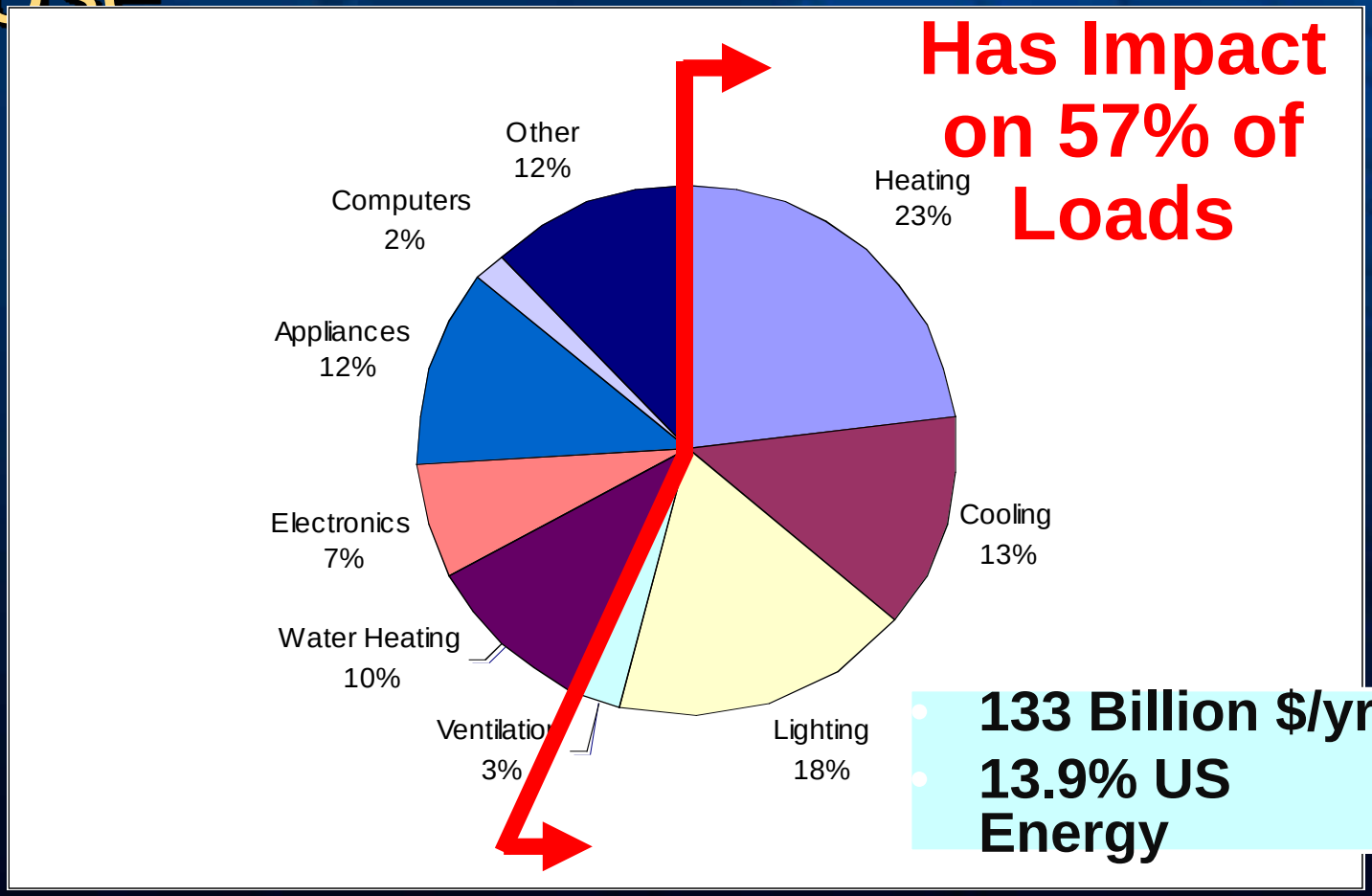
Fenestration Impacts on Energy Use



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Energy Performance Context

- Fenestration is often considered "…the biggest hurdle ..." to achieving significantly higher levels of energy efficiency for the building envelope.
- However, this negative assessment ignores two important sources of energy efficiency for fenestration:
  - Integration of Systems
  - Research and Development (R&D) opportunities

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Integration of Systems

- Substantial energy efficiencies possible when fenestration is integrated with other building systems:
  - Daylighting (envelope, lighting, interiors, and controls)
  - Natural ventilation (envelope, HVAC, controls)
  - Integration of envelope and ventilation portions of HVAC systems

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Research & Development (R&D)

- Significant new energy efficiency potential has been identified over the next decade from several areas of fenestration research at research programs at Lawrence Berkeley National Laboratory (LBNL) and elsewhere:
  - Advanced, Integrated Daylighting
  - Affordable Dynamic windows (electro-chromic)
  - Dynamic shading and glare control devices
  - Commercialize Cost Effective R5 Windows
  - Develop Next Generation of R10 Windows

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Electrochromic Windows R&D over past 10 years

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Fenestration Attributes and Sub Attributes

- Thermal transfer
  - U-Factor
  - SHGC – fenestration assembly
  - SHGC – fenestration + fixed shades
  - SHGC – fenestration + dynamic shades
- Daylighting
  - Percent of building floor area covered
  - Perimeter zone depth
  - Percent of lighting energy reduction
- Natural Ventilation

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Benchmarks-Metrics

- U-Factor for Fenestration Assembly

	U-Factor (Btu/ft2°F hr)			
Climate Zones	*Baseline (PB)*	*(P+) Improved*	*(P++) Enhanced*	*(HP) High Perf.*
CZ 1, 2, & 3	0.70	0.60	0.50	0.40
CZ 4, 5 & 6	0.40	0.35	0.30	0.25
CZ 7 & 8	0.35	0.20	0.17	0.14

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Benchmarks-Metrics-SHGC

- Solar Heat Gain Coefficient (SHGC) for Fenestration Assembly

	SHGC (for fenestration Assembly only)			
Climate Zones	*Baseline (PB)*	*(P+) Improved*	*(P++) Enhanced*	*(HP) High Perf.*
CZ 1, 2, & 3	0.25	0.25	0.25	0.25
CZ 4, 5 & 6	0.47	0.40	0.40	0.40
CZ 7 & 8	NR	0.45	0.45	0.45
	SHGC (for fenestration Assembly plus External Fixed Shades)			
Climate Zones	*Baseline (PB)*	*(P+) Improved*	*(P++) Enhanced*	*(HP) High Perf.*
CZ 1, 2, & 3	0.25	0.225	0.2	0.175
CZ 4, 5 & 6	0.47	0.39	0.38	0.37
CZ 7 & 8	NR	0.45	0.45	0.45
	SHGC (for fenestration Assembly plus Dynamic Shades)			
Climate Zones	*Baseline (PB)*	*(P+) Improved*	*(P++) Enhanced*	*(HP) High Perf.*
CZ 1, 2, & 3	0.25	0.2	0.18	0.16
CZ 4, 5 & 6	0.47	0.38	0.36	0.34
CZ 7 & 8	NR	0.44	0.44	0.44

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Benchmarks-Metrics-Daylighting

- Basic and Advanced Versions
- Integrated with other building systems
- Building form, envelope, lighting, interiors, controls
- Heating and cooling impacts vary by climate location

	Daylighting (% floor area/ Zone depth/ % Lighting Savings)			
Climate Zones	*Baseline (PB)*	*(P+) Improved*	*(P++) Enhanced*	*(HP) High Perf.*
CZ 1, 2, & 3	N/A	51%/15 ft/50%	64%/20 ft/50%	77%/20 ft/60%
CZ 4, 5 & 6	N/A	51%/15 ft/50%	64%/20 ft/50%	77%/20 ft/60%
CZ 7 & 8	N/A	51%/15 ft/50%	64%/20 ft/50%	77%/20 ft/60%

Based upon LBNL Research program estimates and upon EnergyPlus simulations

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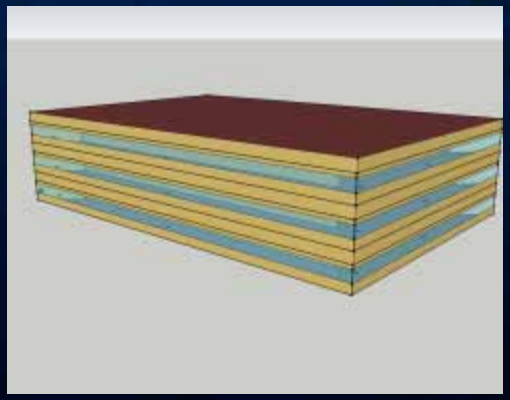
Outcomes - EnergyPlus (E+) Simulations

- Develop Parametric Processor for Simulation of Whole-Building impacts
  - Start with building prototypes from PNNL
  - Develop single medium office file for controlled parametric
  - Start with baselines for ASHRAE/IES 90.1-2004 and 90.1-2010
  - Simulate whole-building energy impacts of improved envelope performance measures
  - Current results preliminary



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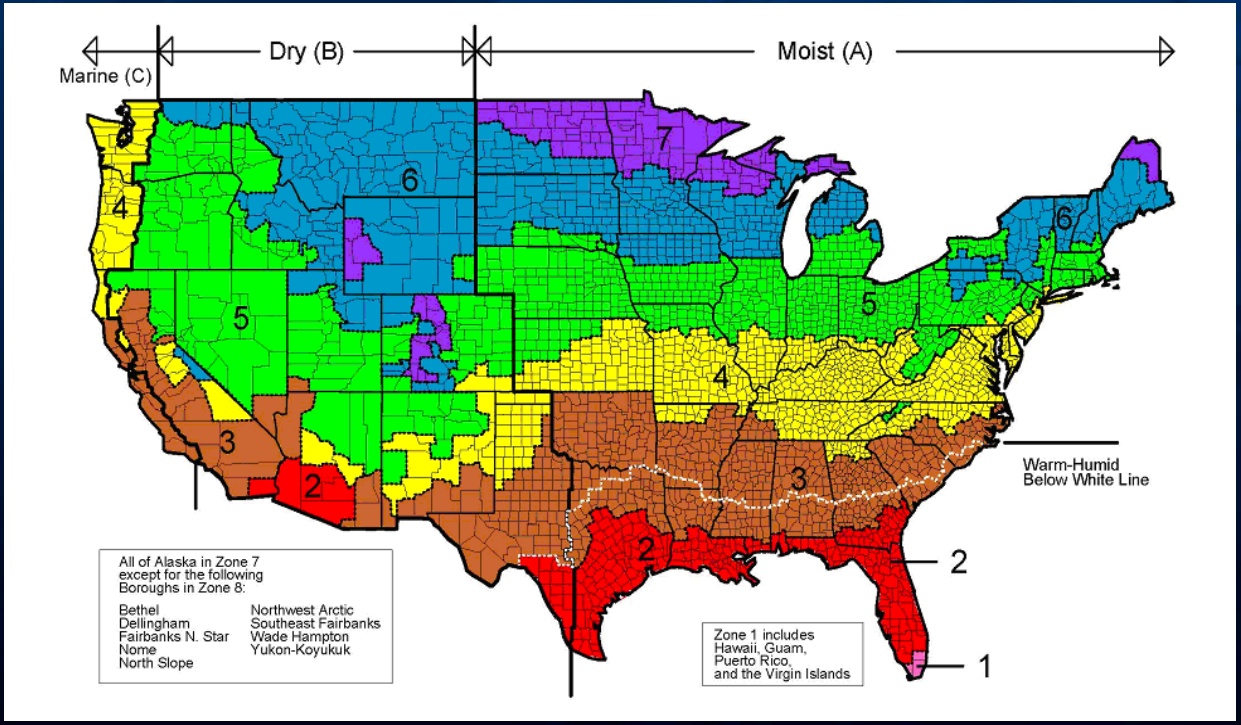
E+ Simulations – Climate Locations

- 7 cities across moist climate zones 1 thru 7, Eastern US & CA
- 5 cities across dry climate zones 2 thru 6, Mountain US & CA
- 3 cities across coastal marine climate zones 3 thru 5.



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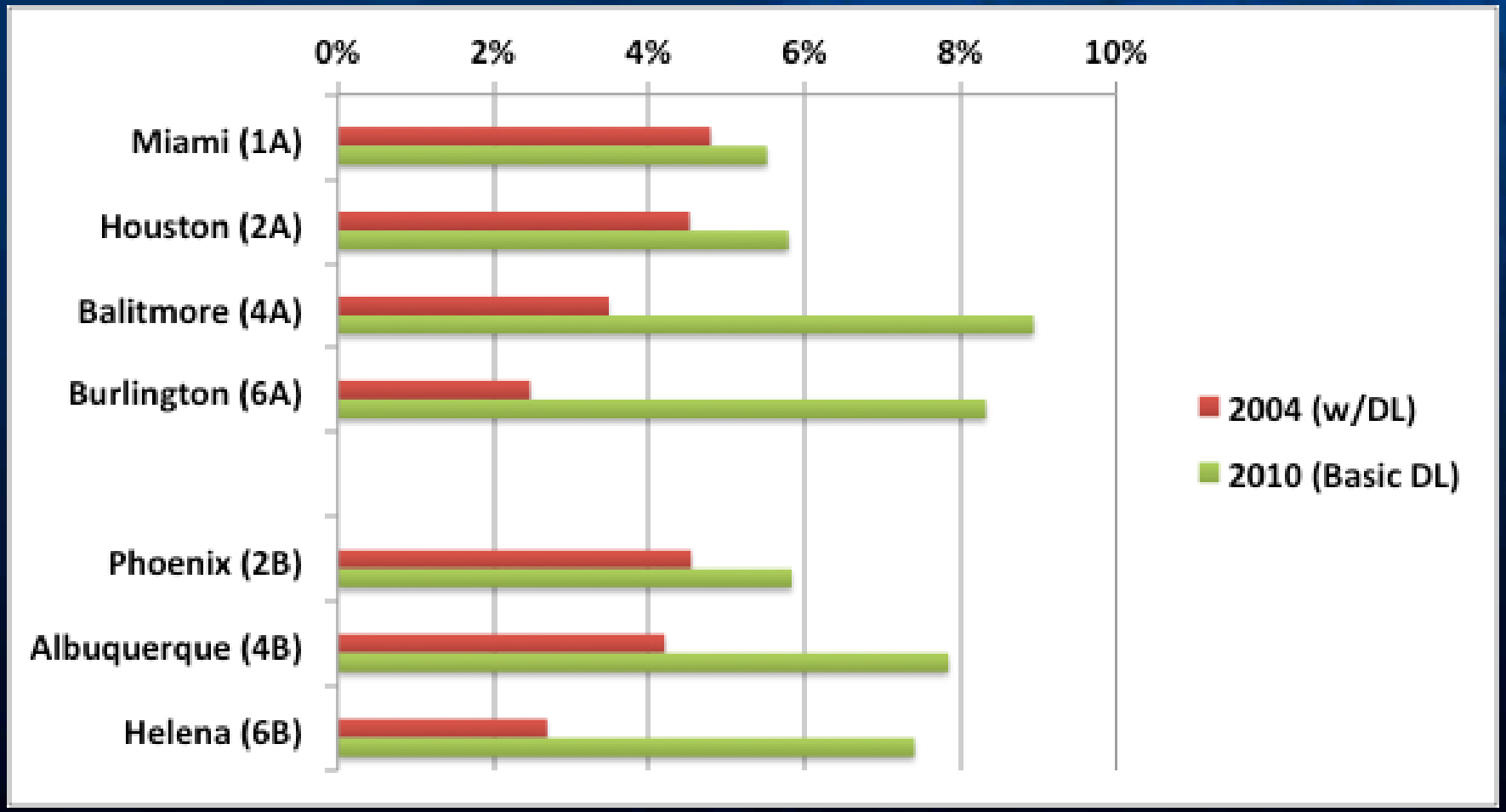
Basic E+ Simulation Results – 90.1-2004 to 2010

Key measures - Basic Daylighting and Continuous Air Barriers



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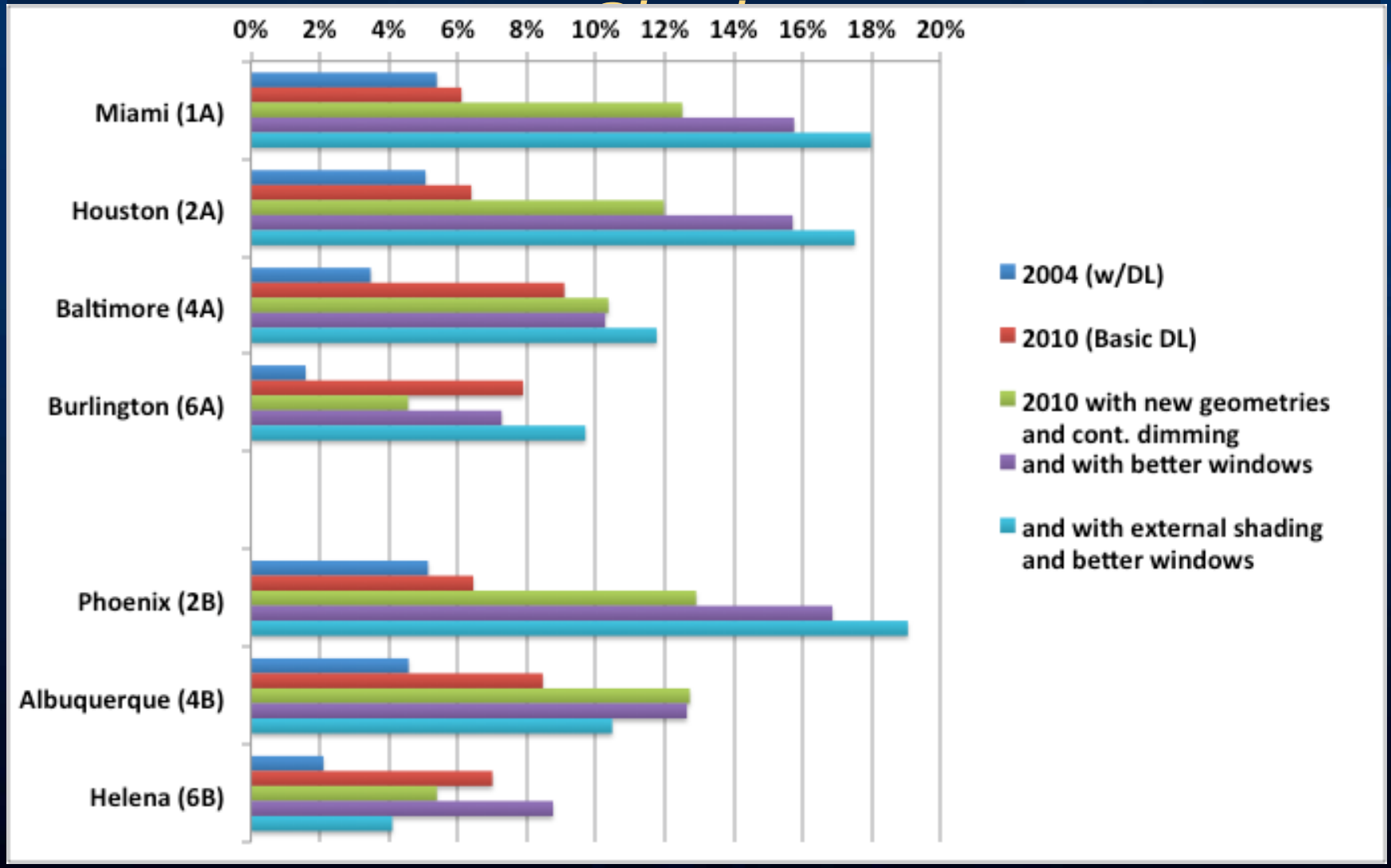
E+ *Advanced Daylighting, HP Glass, & Dynamic*



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Discussion

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